International Harmonized Research Activities - Intelligent Transport Systems
Working Group Meeting
October 25, 1997. Berlin, Germany

Minutes

Attendees:

Dr. Ian Noy (Chairman, Transport Canada, Canada)
Mr. Daniel Augello (Renault, France)
Dr. August Burgett (NHTSA, U.S.)
Dr. med. B. Friedel (BASt, Germany)
Mr. Geoff Harvey (Department of Transport, U.K.)
M. Lies Duynstee (Ministry of Transport, The Netherlands)
Dr. Anthony Ockwell (Federal Office of Road Safety, Australia)
Mrs. Annie Pauzié (INRETS, France)
Mr. Roland Niggestich (Federal Ministry of Transport, Germany)
Mr. H. Peters (TÜV, Germany)
Dr. Wojciech Zdzislaw, (Motor Transport Institute, Poland)
Mr. Kaneo Hiramatsu, (JARI, Japan)
Mr. Ray Kieffer (GM, U.S.)

1. Introduction.

On behalf of the WG, Ian Noy thanked Mr. Niggestich of the Federal Ministry of Transport, Germany for hosting the workshop and the meeting of the Working Group and Dr. Friedel for making the necessary arrangements.

The meeting began with a general discussion of the workshop [*A synopsis of the workshop is attached*]. While several different approaches to evaluation were presented at the workshop, it was difficult to extract procedures (methods and criteria) that could be directly used for safety evaluation. The purpose of the meeting was to develop a detailed workplan for collaborative research. However, different points of view regarding the role of the WG and about the nature of collaboration prevented that objective from being fully met. Nevertheless, a number of important activities have been defined, as described below. [*My note: In order to help focus on the role of the WG and defining collaborative research needs, I have prepared the attached brief discussion document. It is intended to stimulate discussion and does not necessarilty represent the views of all WG members.*]

The discussions, summarized in the following points, reflect the complexity of evaluating ITS safety as well as differences of opinion regarding the nature of WG direction and deliverables.

- Some felt that governments should not test safety after-the-fact, but should work in cooperation with industry during product development. While industry/government cooperation is in fact underway in some countries, it does not address the need for governments to develop intervention strategies for products that may increase the risk of collision.

- It is difficult to assess safety prospectively, especially as safety is not well understood despite decades of research in related fields (such as traffic management, effects of drugs). There is a need for more baseline data about driver behaviour. Others pointed out that many ITS products are very near market introduction and there is an urgent need to define safety indicators, although it did appear that safety indicators could be elaborated or agreed (e.g., there was a reluctance to put forward indicators such as "glance time to IP" or "time headway" since these are context and driver dependent).

- The issue of ITS safety is extremely complex and many felt the mandate of the WG is too ambitious, as stated. Moreover, the feasibility of developing generic procedures was questioned and a suggestion made that specific technologies should be addressed individually.

- Some felt that the WG should develop guidelines for convenience products and detailed requirements for collision avoidance systems (CAS). Some felt we should target our efforts to develop a code of practice with guidelines for design.

- Some expressed a need to continue the workshop concept, but to place emphasis on procedures. Others indicated we need a critical review of the state of the art. This will be addressed to some degree by the survey and future workshops.

- Techniques such as simulation may be good developmental tools, but may not be appropriate for final test and evaluation (e.g., certification).

- It was pointed out that industry employs a number of tools during the development of a product. Also, ISO and other groups are working on minimum performance requirements for specific systems (e.g., MMI, ACC) and these should address issues concerning interoperability and consistency of operational characteristics (such as minimum headway, deceleration rate and speed range of operation).

- The question of content-oriented requirements versus process-oriented requirements was raised. A content oriented requirements specifies the test procedures and criteria to be met. It could be as simple as a checklist with performance indicators or an elaborate test protocol using simulation or on-road tests. In a process oriented requirement, the issues are enumerated along with possible evaluation techniques. Manufacturers must demonstrate that they have used appropriate techniques to address issues of safety during the R&D cycle. The process requirement would also address the qualifications of the individuals involved and the corporate process for incorporating results in the final design.

2. Activities

2.1 Survey.

A draft survey form was distributed and discussed. It was decided that the survey will be confined to automotive research (i.e., will not include aviation, etc.). It was agreed that final editorial comments would be sent to Ian Noy by November 13. The final survey will incorporate comments received from WG members and be faxed and sent electronically to

WG members (and GFP for countries not represented in the WG) for completion. The WG member or GFP is responsible for assembling the set of completed forms for each country and forwarding the set to Ian Noy by February 1, 1998. These will be used to create a database which will be made available to WG members.

At its next meeting, the WG will decide how the database will be evaluated. An initial analysis will be made by Transport Canada and submitted to WG members.

2.2 Guidelines

Several guidelines have been developed by different organizations (e.g., UK Code of Best Practice, draft German guidelines submitted to WP29, MISRA guidelines, guidelines developed under GEM and similar EC projects). The WG agreed to review all of these guidelines with a view towards determining their usefulness in the development of content or process requirements. All agreed to forward guidelines to Ian Noy by the end of December. [*Note: ISO TC22.SC13/WG8 is developing a standard on "suitability of TICS" which could also be important for this WG*]

TC will undertake a review of process oriented guidelines to determine their potential utility for the WG.

2.3 Framework

It was agreed that the work of the WG is to develop a framework for evaluation. As the first step towards the WG agreed to consider the matrix contained in the paper by Louis Tijerina, "An Approach to Comprehensive Evaluation of Lane Change Crash Avoidance Systems", that listed possible evaluation techniques against a set of relevant safety issues. This matrix could be expanded to include issues raised at the workshop that are not reflected. Once such as framework is agreed, the elaboration of the techniques would be assigned to different members of the WG.

Other evaluation frameworks may have been previously developed under Drive II and similar programs. It was therefore agreed to obtain other such material in order to ensure that the framework considered by the WG is as comprehensive as possible.

It was agreed that each member of the WG will examine the matrix and provide comments. Specifically, the comments should identify safety-relevant issues not addressed by the matrix, suggest the inclusion of additional techniques that are relevant but are not presently included, and any techniques that may be included but are not considered valid. Comments are due by the end of February.

2.4 Inventory of Projects

An important aim of the WG is to facilitate collaboration in relevant research. One way to accomplish this is to match members' research interests with research projects underway in different countries. For example, it might be useful for the Dutch researchers to find a project in another country to further test and develop the PC-checklist. Similarly, VTI may wish to simulate a specific scenario being researched using closed-track techniques in another country to examine questions of validity and calibration. In order to accomplish this, it was agreed that all members provide descriptions of research projects within their

country which are open to collaboration. These projects do not necessarily need to be directly sponsored by government, but the sponsors must be willing to collaborate. These descriptions are due by the end of December. The length of the descriptions is left to discretion of WG member submitting the project but should be sufficiently detailed so that others can identify potential hooks for their interests (e.g., how they could link).

Ian Noy will distribute these descriptions to WG members in early January. WG members will then review the set of projects, discuss them with appropriate national researchers and identify the projects on which they are interested to collaborate. They will select projects that they can complement with a new technique or contribute unique competences. Resources for this collaboration will be the responsibility of the party wishing to collaborate.

3. Future Meetings

The next meting of the Expert Group was tentatively scheduled for March 26-27, 1998 in London. The meeting will commence at 13:00 hrs on Thursday and end at 15:00 hrs on Friday. A further meeting of the Expert Group will be scheduled in conjunction with ESV98 in Windsor, Canada. Publication of the results of the survey will be targeted for ESV98.

4. Action items

- August Burgett to send Ian Noy elaboration of survey Q 1.5 by Nov 13, 1997
- All WG members to send me comments on survey by Nov 13, 1997
- All WG members to send description of current projects that are open to collaboration by Dec 31, 1997
- Kaneo Hiramatsu to provide JAMA guidelines by December 31, 1997
- Geoff Harvey to provide UK code of best practice, MISRA and GEM guidelines by December 31, 1997
- Dr. Friedel to provide copy of German guidelines by December 31, 1997
- Lies Duynstee to summarize Dutch PC-based checklist by December 31, 1997, assuming results will be available, and to determine if software can be shared with WG.
- All WG members to complete survey and submit by Feb 1, 1998
- All WG members to identify current projects they can contribute to by Feb 28, 1998
- All WG members to provide comments on framework by February 28, 1998

5. List of Attachments

1. Synopsis of Workshop
2. Framework from paper by Tijerina, *An Approach to Comprehensive Evaluation of Lane Change Crash Avoidance Systems*
3. Informal doc. No 5, to WP29, *Information and Communication Systems: Safety and MMI,*
4. Japan's Safety Guideline on In-Vehicle Display Systems
5. Discussion Document
6. Survey

Synopsis of Workshop on ITS Safety Test & Evaluation
Ian Noy

The workshop technical program is attached. There were many good presentations covering a broad range of evaluation techniques - too many, in fact, for meaningful in-depth discussion. Some of the techniques presented are summarized below. Many important aspects of evaluation were raised that are not immediately apparent. For example, the need to consider the impact on non-equipped vehicles and the influence of driving style on test results are important considerations in the evaluation of safety.

Several European projects have attempted to address this topic, with limited success due to lack of continued funding. Specifically, Drive II projects (HOPES, HARDIE, EMMIS, and GEM) attempted to prepare frameworks, guidelines, and methodologies for safety assessment of in-vehicle systems. They collected a lot of data and developed, manuals, database, and tools such as Skill Acquisition Network (SANe) and Dialogue Design and Evaluation Method (DIADEM). However, the results of these efforts have not addressed safety per se, they lack full scale context and employ too many measurements. Continuation of these types of studies have not been supported by EC.

Summary of techniques presented

1. Usability testing using field operational tests, including de-briefings and focus groups (ref: UMTRI ACC study, J. Sayer). A feature of the data acquisition system was identification of events of interest (e.g., lane change) and capture of video data prior to and following event. The importance of collecting baseline data by individual parameters (e.g., age) was emphasized.

2. Field operational tests (ref: PSA Peugeot Citroen study of ICC, Florence Nathatn). Collected numerous additional data in addition to human factors data, to facilitate communication with engineers. Raised the issue of effects on drivers of non-equipped vehicles and other road users. Also indicated the need to include individual difference parameters such as driving style.

3. Open-road evaluation using behavioural and verbal protocol analysis to obtain insight into driver strategic behaviours (ref: INRETS/Renault study, F. Saad). Researchers analyzed general behavioural data as well as specific lane change manoeuvres. Concluded drivers of ACC-equipped tend to exhibit fewer manoeuvres and greater left lane driving. Also showed an overall reduction of time headway with ACC. However, when performing lane change manoeuvres, time headway depended on traffic conditions (higher with ACC under lighter traffic and higher when pulling out to pass with ACC). Concluded that situational variables and driving style are important factors.

4. Simulation for prospective evaluation of safety (ref; Lena Nilsson). A major point raised was the need to look at the individual road user as well as effects on traffic and society (as filtered through the traffic system). However, we do not have an adequate understanding of safety and therefore must rely on surrogate measures.

5. Computer-based checklist (ref; Karel Brookhuise). The development of a relatively quick prospective assessment of IVIS was described. This is still under development in the Netherlands.

6. Secondary task methodology to assess mental demand in laboratory and in the field (ref: University of Cologne, Hering).

7. Combination of techniques to address a comprehensive evaluation of the issues (ref; Tijerina) during CAS development. A framework for evaluating lane change crash avoidance systems was presented as an example. The framework consists of a series of questions to be considered during evaluation and indicates the possible methods that might be applied to address these questions. A comprehensive evaluation should address at least the following questions:

   Does the CAS address driving conditions related to crash involvement?
   Does the CAS logic support driver's decision making tasks?
   Is the CAS display location compatible with normal driver behaviour?
   Does the CAS match the driver's sensory characteristics?
   Is the CAS display content meaningful to the driver?
   Does the CAS have any unintended negative safety consequences?
   Does the CAS reduce crash incidence or severity?

   These questions should be expanded to address the impact on drivers of non-equipped vehicles and other road users as well as on the overall traffic patterns.

Other Information

Ford and GM have established a program of collaborative research, Crash Avoidance Metrics Partnership (CAMP), to accelerate development of ITS countermeasures by pre-competitive assessment of the need, feasibility and marketability. CAMP dropped ACC because technologies are too near to market. Current area of interest is rear-end collision countermeasures. Methodology includes development of relevant scenarios, functional requirements and test methodology. CAMP developed a rear-end surrogate target for closed-track performance tests.

NHTSA current research in three categories: projects related to specific collision types (rear-end, road departure, lane change and merge, heavy vehicle stability, intersections), driver performance (driver status monitoring, vision enhancement, human-vehicle interaction), and post-collision injury mitigation. The Intelligent Vehicle Initiative (IVI) developed to facilitate product deployment, includes development of services (autonomous and cooperative), selection of services for integration, integrated system design and development, operational tests and evaluation.

Ian Noy, Canada	Introduction to Workshop
August Burgett, U.S.A.	The Development of Objective Test Procedures as Part of the Intelligent Vehicle Initiative
Mark Fowkes, U.K.	UK Perspective on the Need for Coordinated International Research
Gene Farber, U.S.A.	Status of the Collision Avoidance Metrics Program (CAMP)
Oliver Carsten, U.K.	New Evaluation Methods: Progress or Blind Alley?
K. Hering, Germany	Procedure for Comparative Assessment of Cognitive Load in Road Traffic
	LUNCH
Karel A. Brookhuis, Netherlands	Computerized checklist for evaluating safety of In-Vehicle Information Systems (IVIS)
Louis Tijerina, U.S.A.	An Approach to Comprehensive Evaluation of Lane Change Crash Avoidance Systems
Lena Nillson, Sweden	The Role of Simulation in Prospective Evaluation of ITS: Can Simulation Techniques Be Used to Determine If an Application is Safe or Unsafe?
Farida Saad and Thérèse Villame, France	Assessing New Driving Support Systems : Contribution of an Analysis of Drivers' Activity in Real Situations
Mr Lauchlan Macintosh	Implementation of In-vehicle ITS Applications to Improve Road Safety in Australia
	BREAK
Kaneo Hiramatsu, Japan	Overview of Japanese human factors ITS research
Jean-François Forzy, France	Ergonomic Evaluation of the Driving Support Systems: The Case of a Route Guidance System
Thérèse Villame, France	Assessment of the Influence of an ACC System on the Driving Activity: Methodological Issues for Data Collection and Analysis
James R. Sayer, P.S. Fancher, R.E. Ervin, and M.L. Mefford, U.S.A.	Adaptive Cruise Control: Results of Usability Testing From a Field Operational Test.
Florence Nathan, France	Ergonomics in Driving Support Systems Design Process : Example of Intelligent Cruise Control

The Role of IHRA-ITS WG: Safety Test and Evaluation

Discussion Document

At the October 1997 meeting in Berlin the group had difficulty focusing on the workplan, partly due to the complexity of the challenge facing the WG and partly due to different points of view and expertise represented within the group. In order to attempt to sharpen the group's focus, I have taken the liberty of enumerating some fundamental principles which need to be either accepted or amended.

1. The WG is concerned with summative evaluations (rather than formative evaluations), that is final evaluations which apply to products that have been developed to the point of being ready for implementation in the real world. In the normal course of development, products undergo design iterations that involve the acquisition and analysis of relevant human and other data. Formative evaluations that are conducted in the course of product development are beyond the scope of the WG. However, it is recognized that such activities are important and contribute to overall system safety. While they are normally conducted by industry, governments often assist in the analysis of collision data and the formulation of operational requirements or design guidelines when the systems being developed fall within the realm of collision countermeasures. It is important to understand that the mandate of this WG does not include formative evaluations. Instead, the goal is "to develop procedures (including methods and criteria) for the evaluation of safety of in-vehicle information, control and communication systems with respect to human performance and behaviour" and is intended to address cross-cutting issues rather than to focus on specific applications.

2. It is recognized that industry's role is to develop products that are effective, safe and acceptable to the public. Government's role is to ensure that products comply with appropriate safety criteria. The development of such criteria is the business of this WG. It should be noted that while there are numerous groups developing standards and operational requirements, no other body is addressing summative evaluation criteria.

3. The WG is concerned with collision avoidance systems as well as systems that are intended to enhance driver convenience.

4. Summative evaluations can be either content oriented or process oriented. Content oriented evaluations implement prescribed test protocols and compare measured values against a pre-established criteria. Process oriented evaluations review product design and development processes to ensure that relevant safety issues were considered, that appropriate standards have been consulted, that appropriate formative evaluations have been performed and that results have been adequately reflected in the final design.

5. Regardless of the type of standard that will eventually emerge (content or process), the standards will require the development of a framework for evaluation. This framework will enumerate a set of safety issues that are to be assessed and identify, for each issue, possible techniques that can be used to address the issue. As it is unlikely that absolute system performance criteria can be specified, the techniques will take the form of comparative evaluations. Hence, to be useful for safety assurance, benchmarks will need to be established. The techniques will also need to specify safety indicators, or measures

believed to be relevant to safety. A major item for the WG, therefore, is to develop the specific elements of the framework.

6. The WG should also monitor formative evaluations and activities/programs that aim to develop operational requirements for collision avoidance systems as well as human-machine interface standards. While the WG will not develop minimum requirements for collision avoidance systems or MMI standards, it may refer to them once their effectiveness will have been established.

7. The overall role of the WG with respect to ITS safety T&E is depicted in Figure 1.

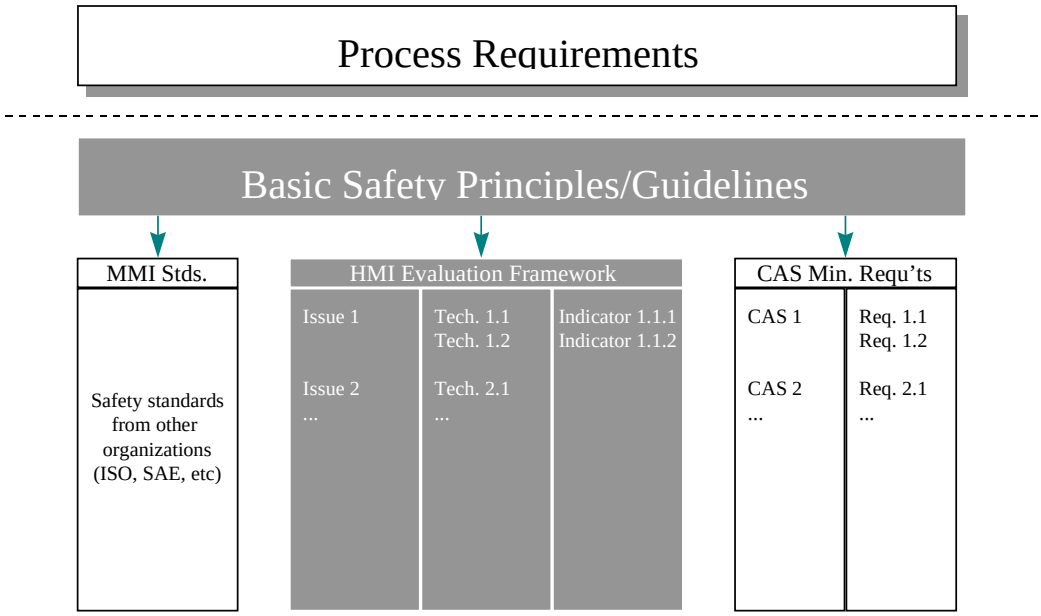

Figure 1: ITS Safety Test & Evaluation Requirements

The essential work of this WG is indicated by the shaded boxes. There are two main elements; basic safety principles/guidelines, and HMI evaluation framework. The basic safety principles/guidelines provide operational and design information that would ensure that products are compatible with general driver characteristics. For example they would ensure that ITS products that are available while driving do not overload the driver or intrude on the driving task. Several such guidelines now exist. They will need to be assembled, compared evaluated and consolidated.

The second role of the WG is to develop an HMI evaluation framework (see item 5, above). The specific elements of the framework will have to be elaborated before further consideration can be given to how such a framework can be implemented.

The boxes to the left (MMI standards) and right (CAS minimum requirements) of the framework represent work underway elsewhere (e.g., within industry, other governments, and standards organizations). They are shown to give an overall perspective of a comprehensive

safety assurance program which should incorporate relevant information from all of the boxes. ITS safety assurance requires reference to all of the elements. For example, all ITS products will have to comply with the basic principles and relevant MMI standards. In addition they will have to undergo test and evaluation as indicated by the HMI evaluation framework. If they are CAS, they will have to meet additional applicable minimum performance requirements.

The dashed line separates procedures and criteria developed within the a context of collaborative R&D from regulatory requirements. A process-oriented regulation (as descrbed above) is shown as referring to all of the elements in the diagram. This is not necessarily the way safety will ultimately be regulated, and other possibilities can be substituted in this box.